Seasonal Variability of Mars H Escape from MAVEN/IUVS

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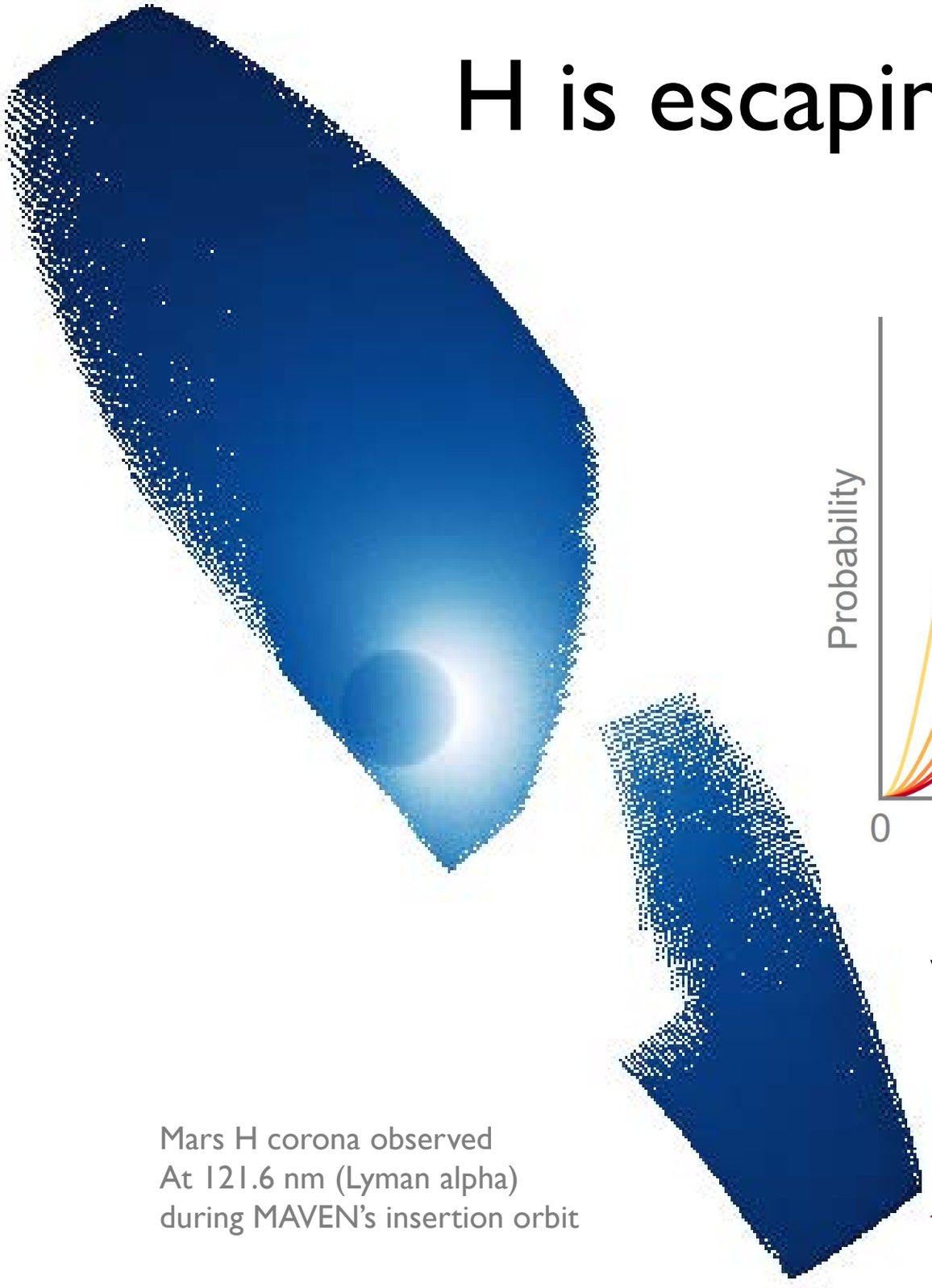
ESA/ESLAB

17 May 2018

Mars H corona observed
At 121.6 nm (Lyman alpha)
during MAVEN's insertion orbit

H is escaping from Mars today via thermal escape



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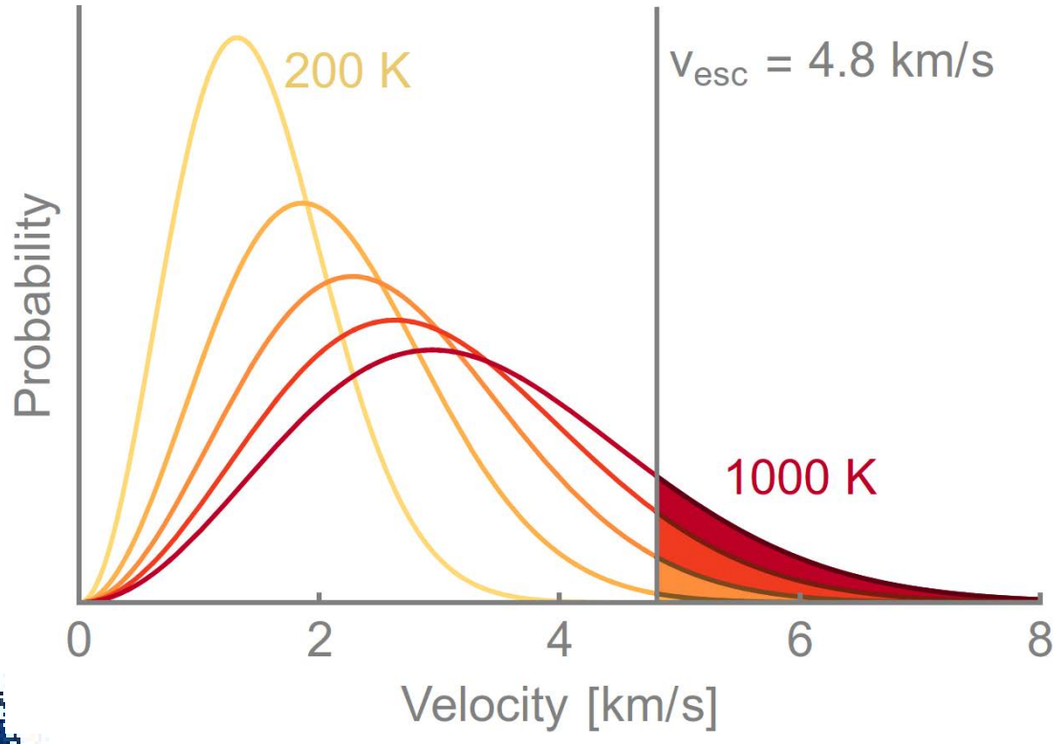
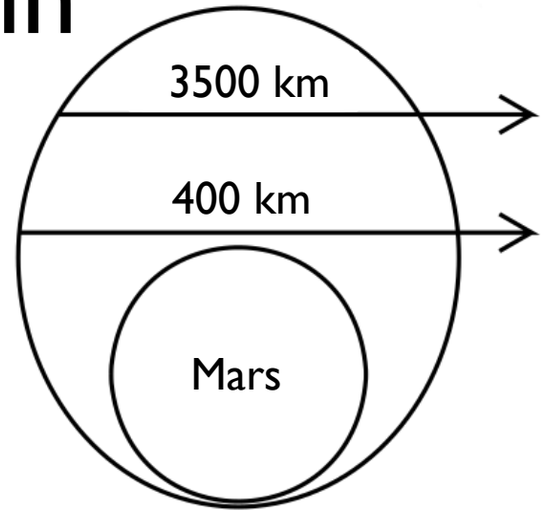
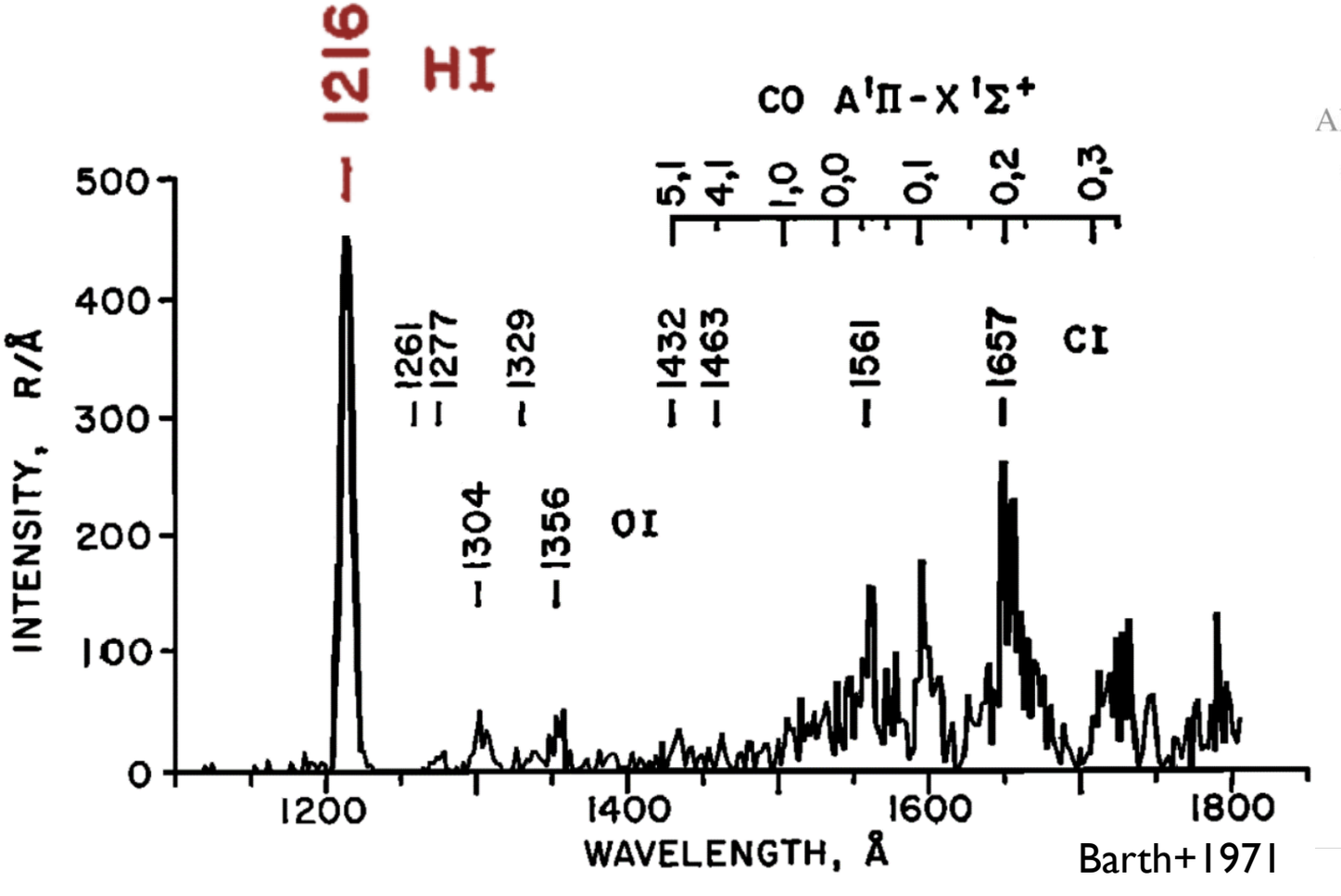


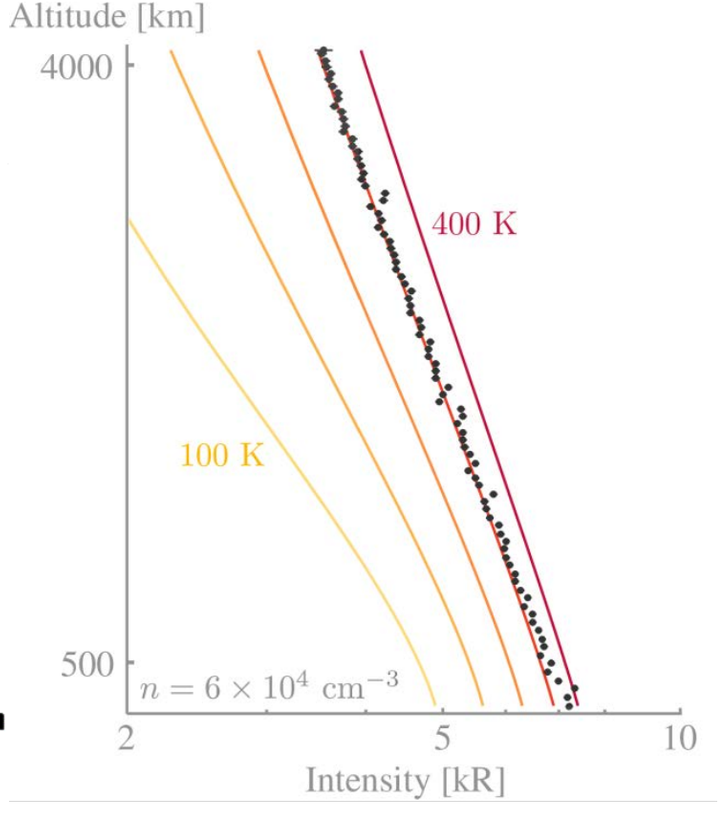
We model escape with a 1D collisionless exosphere controlled by the density and temperature at the exobase.
(velocity distribution)

Observations across the orbit obtain brightness profiles with altitude

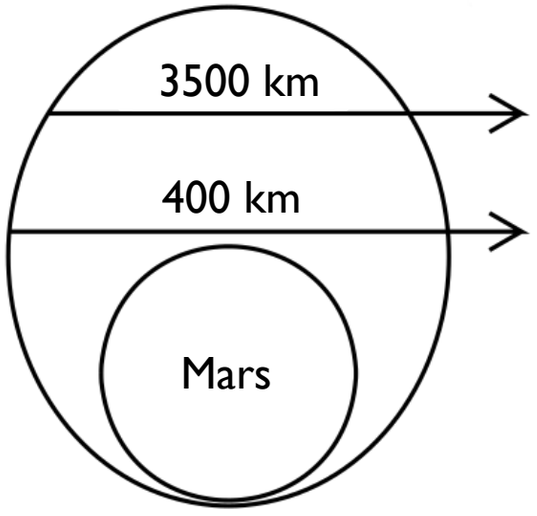


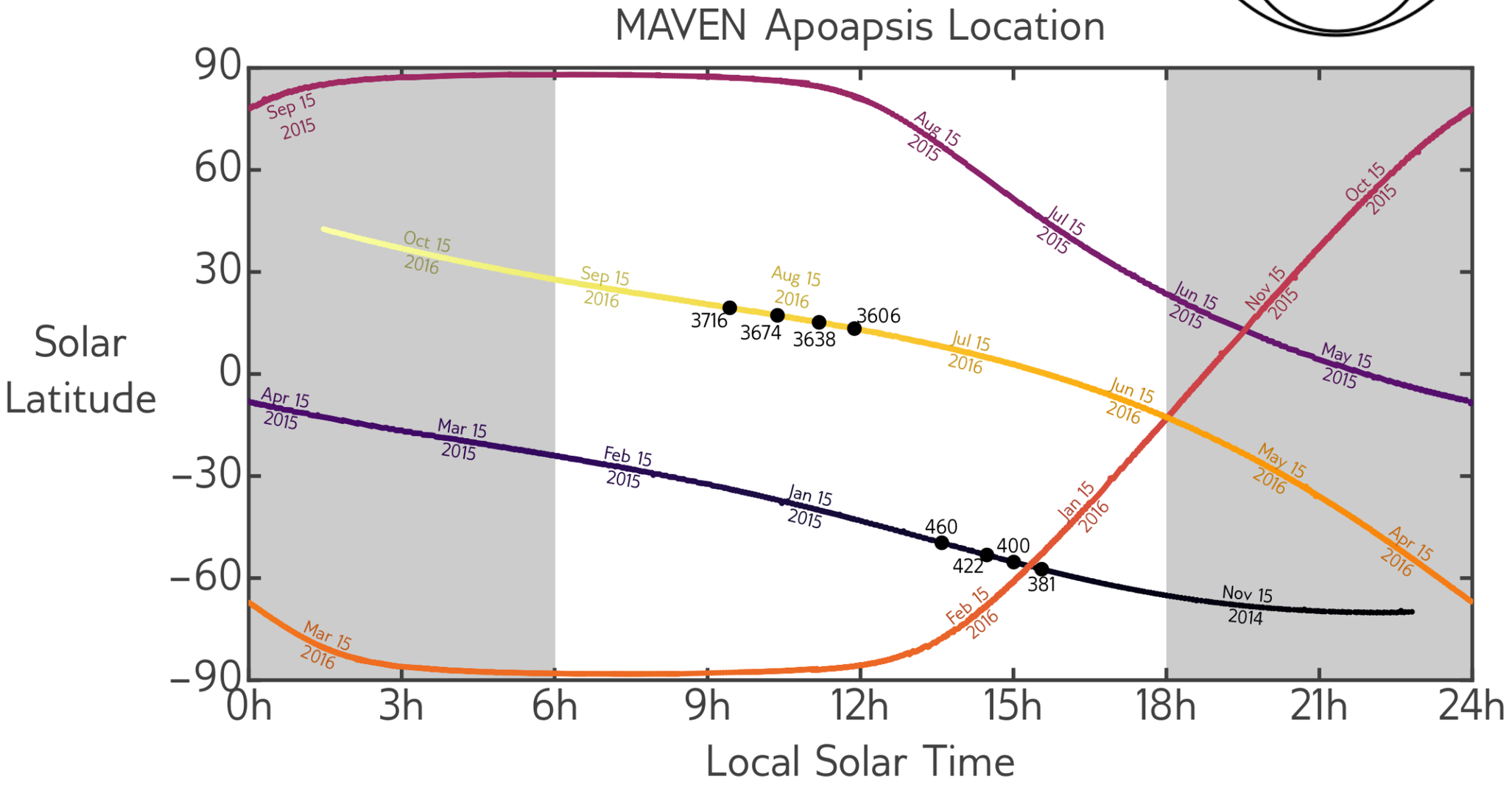


Barth+1971

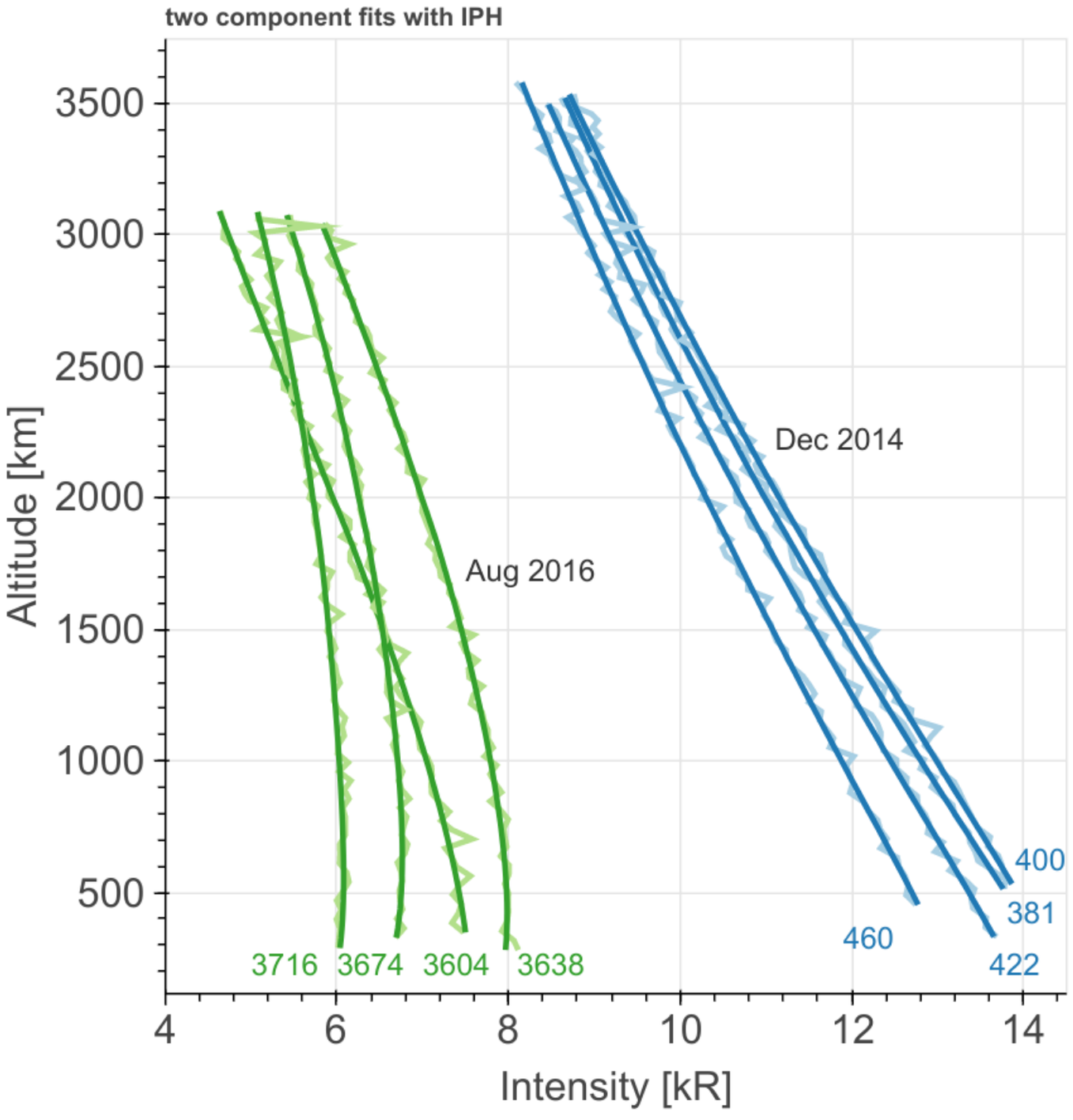


Spacecraft precession limits available coronal scans





Escape rates are inferred from model fits

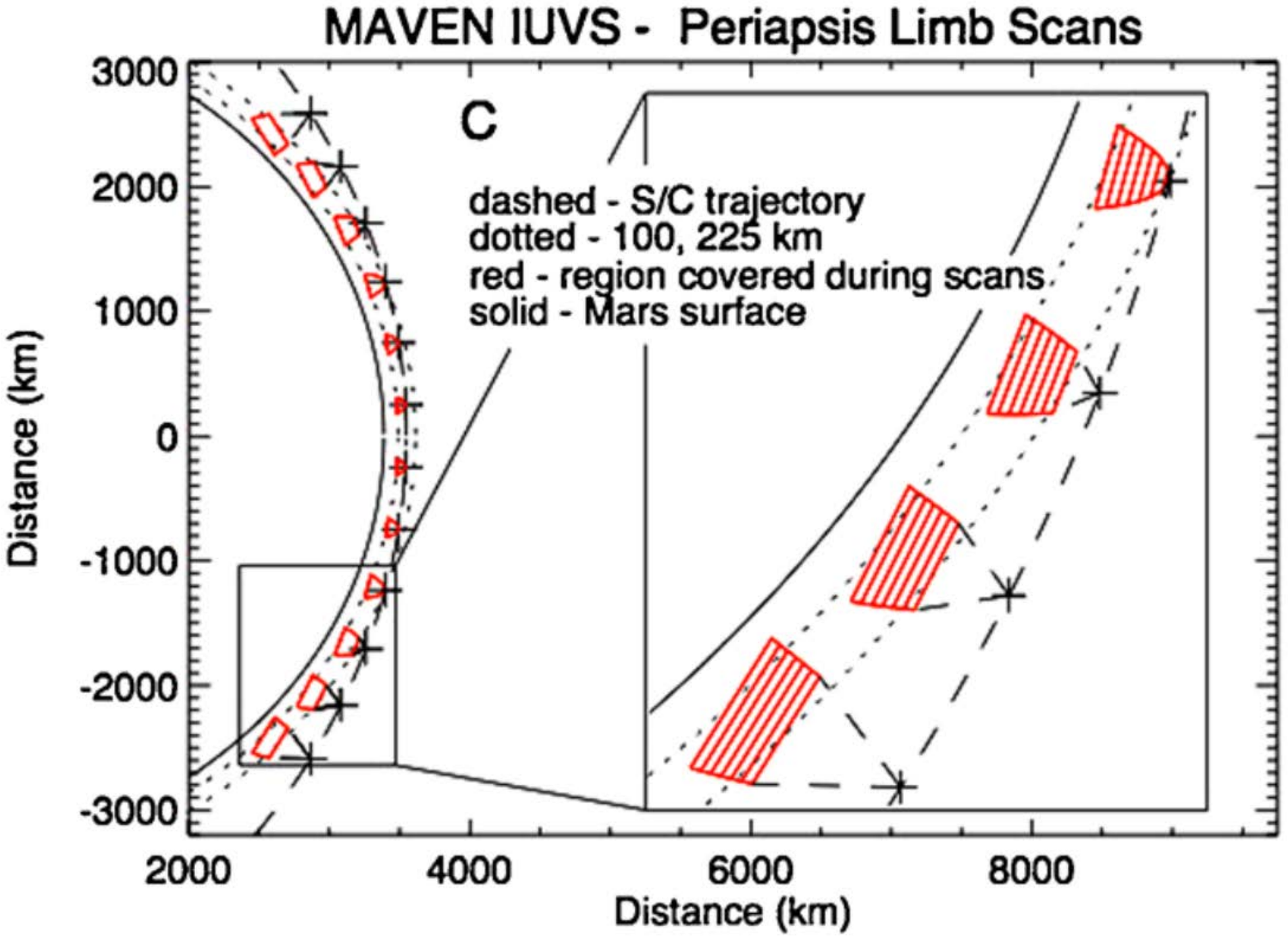


Brightness is consistent with hot + thermal H or thermal H + D.

Inferred escape rates are 1-8 x $10^8/cm^2/s$.

Results are consistent with previously inferred seasonal variation.

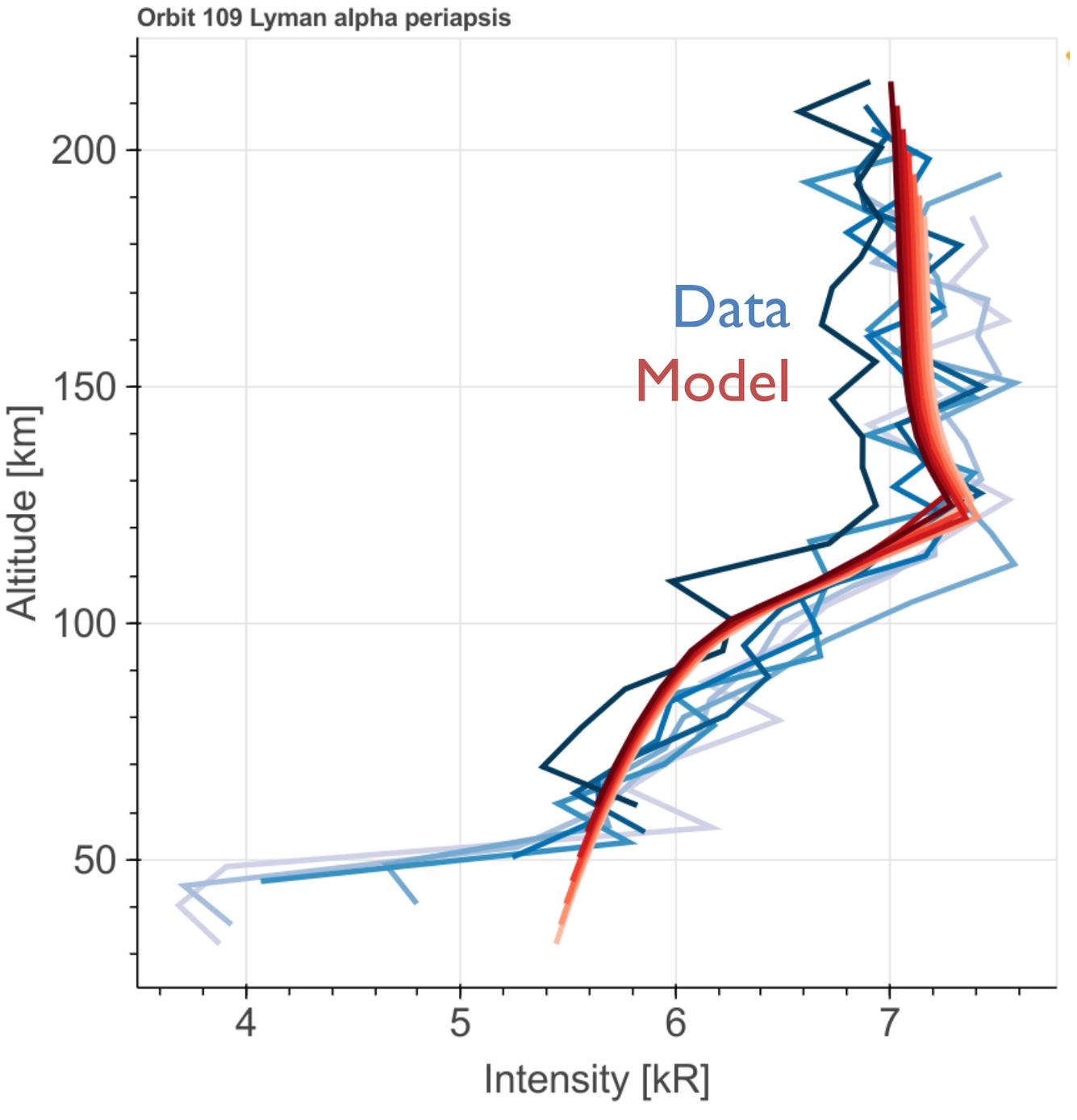
Periapsis Lyman alpha can constrain H escape



Periapsis Lyman alpha can constrain H escape

Profile topside probes H

Bottomside controlled by CO2 absorption.
(CO2 density is constant in current model)



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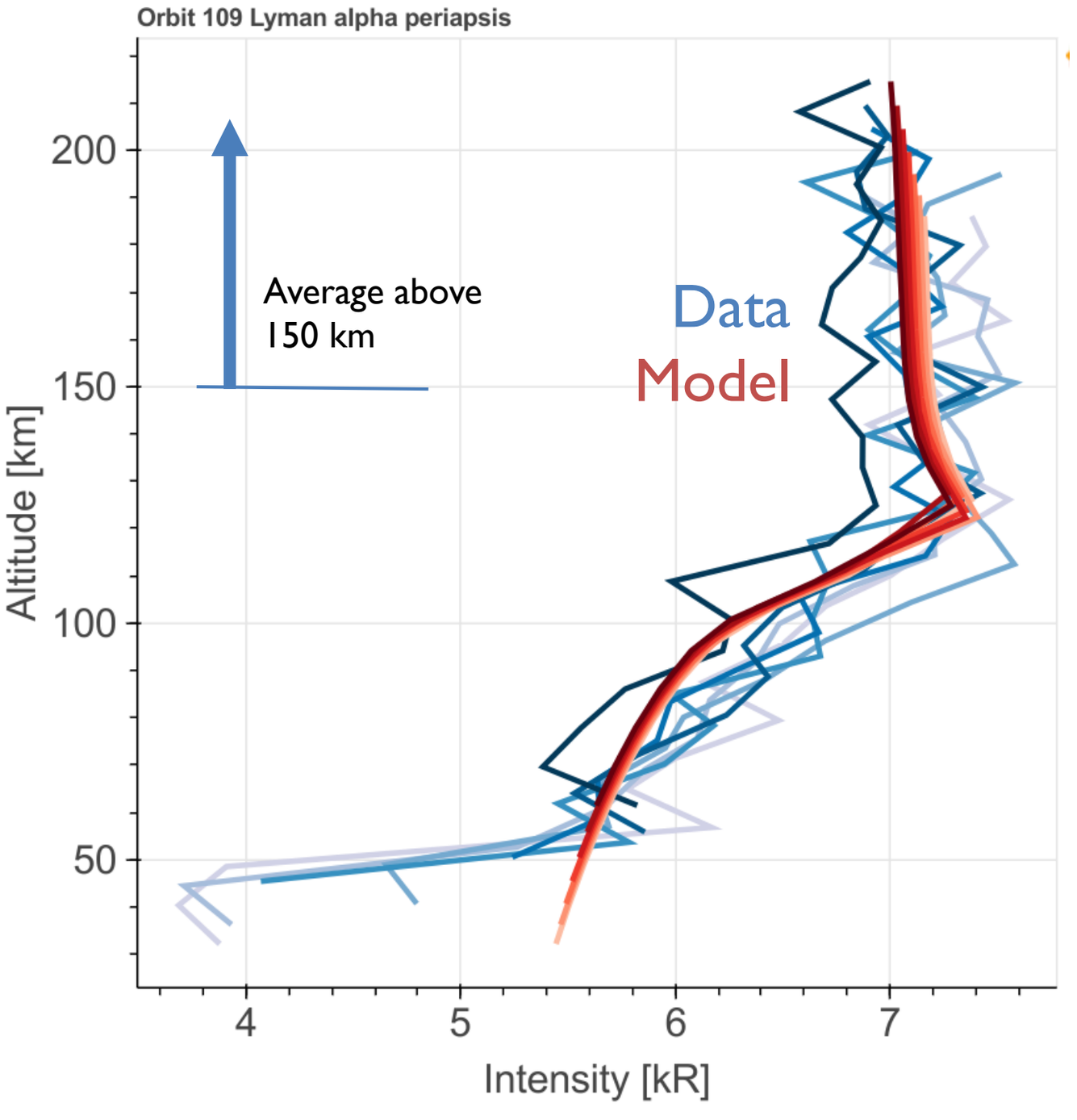
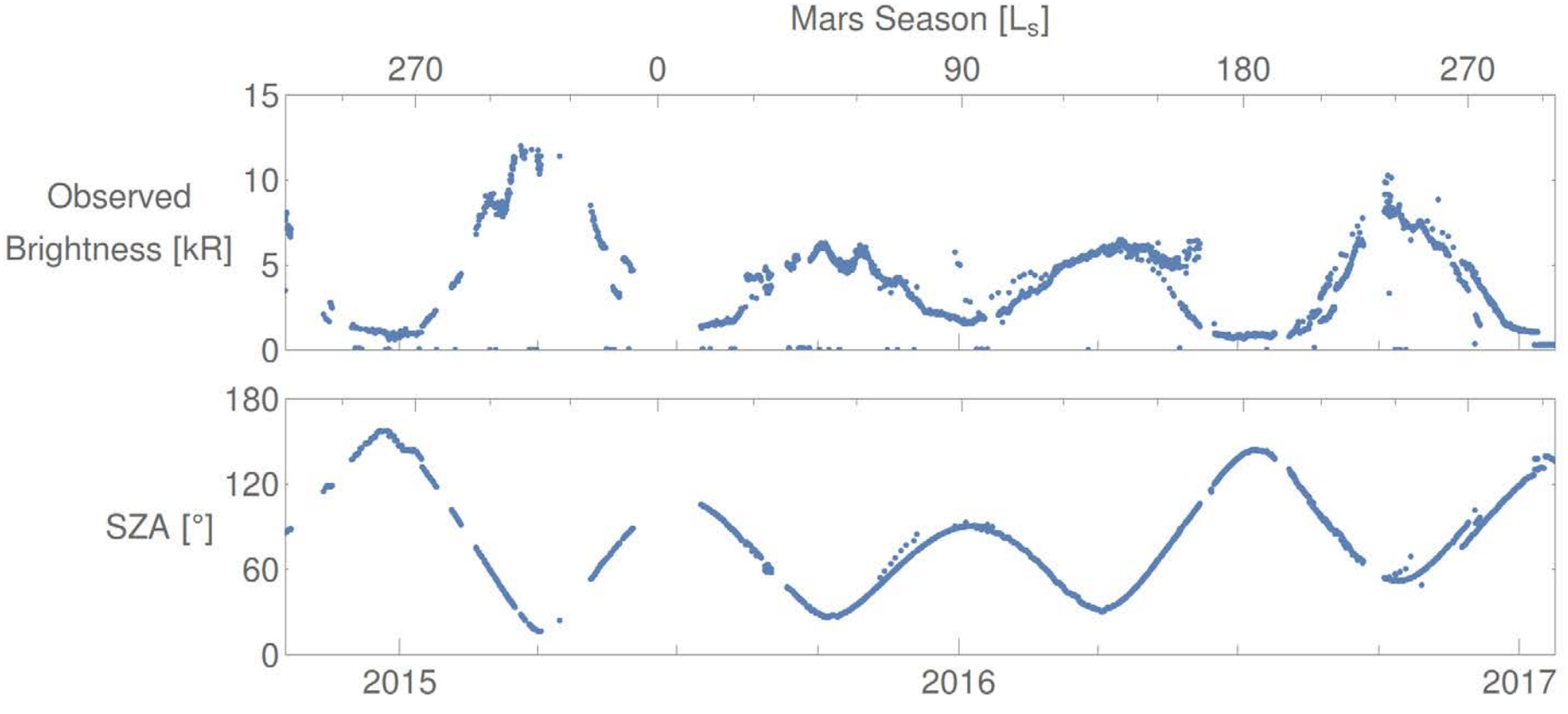


Periapse brightness reveals seasonal variation



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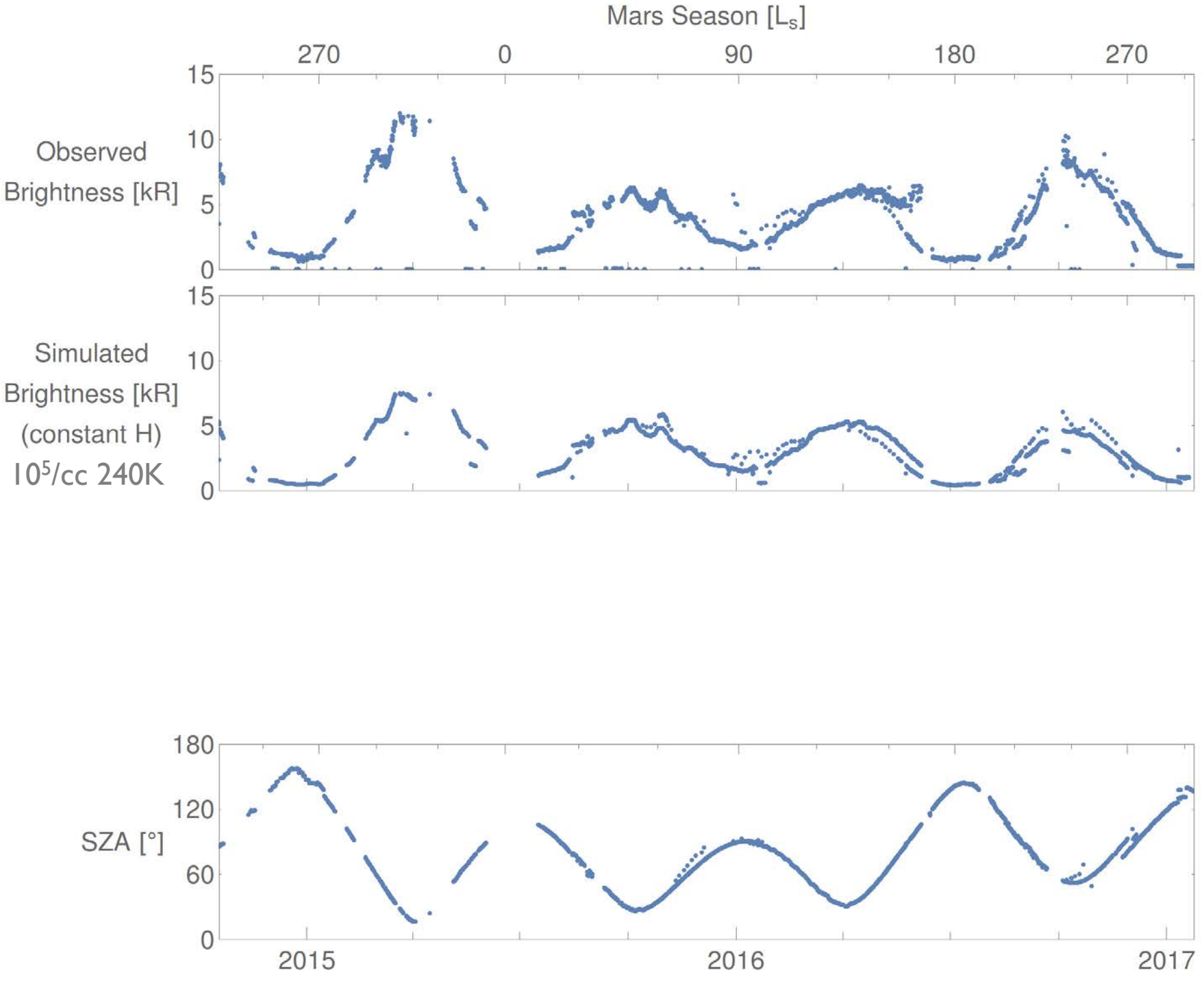

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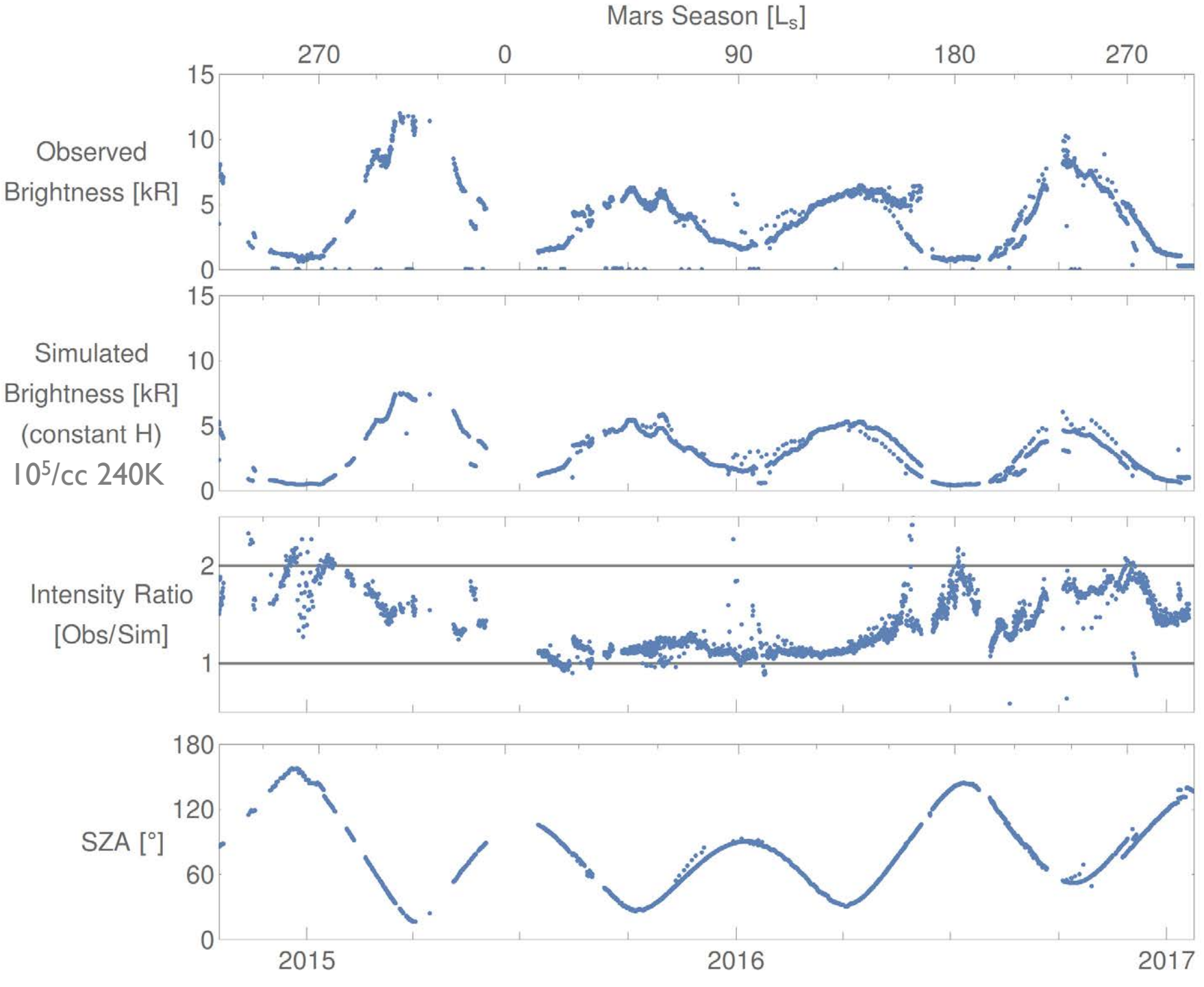
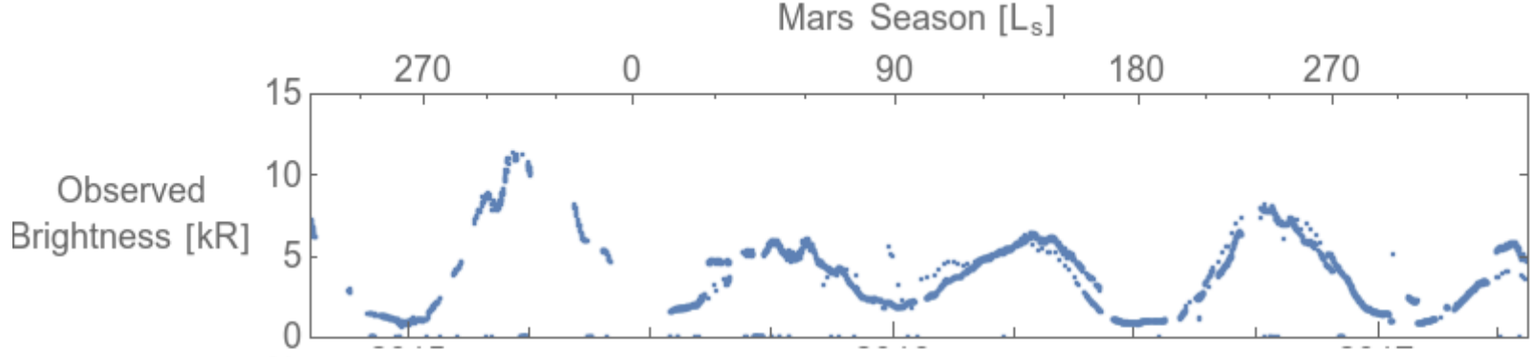
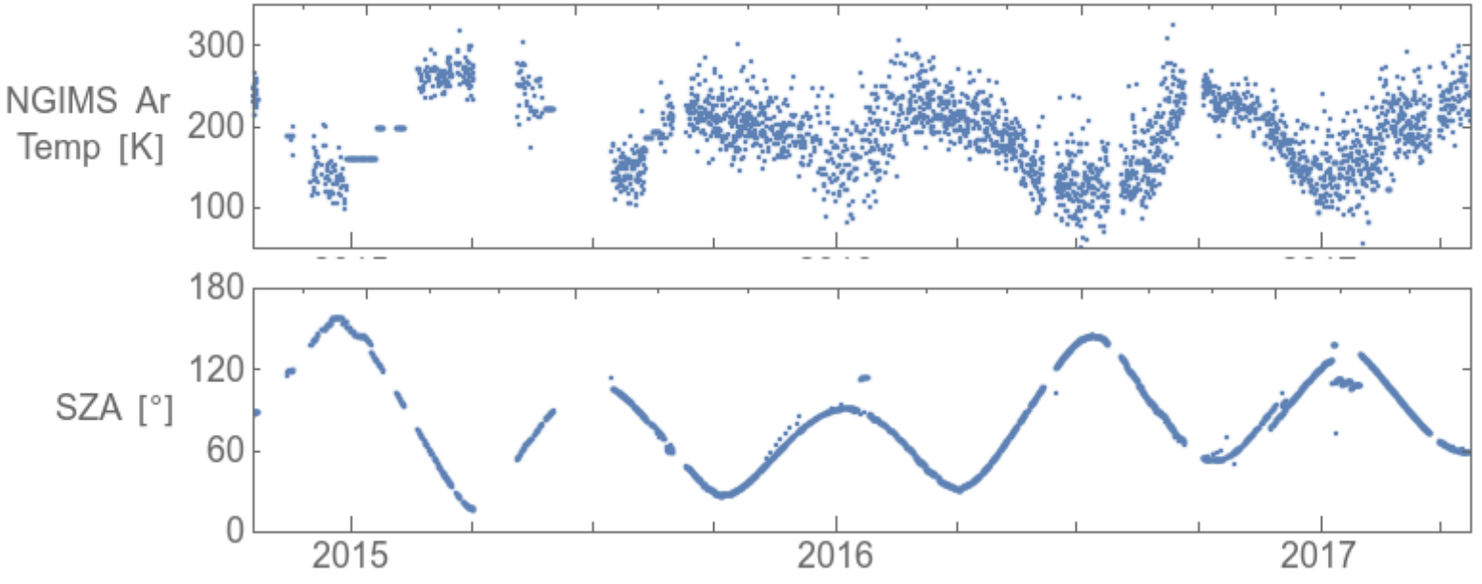


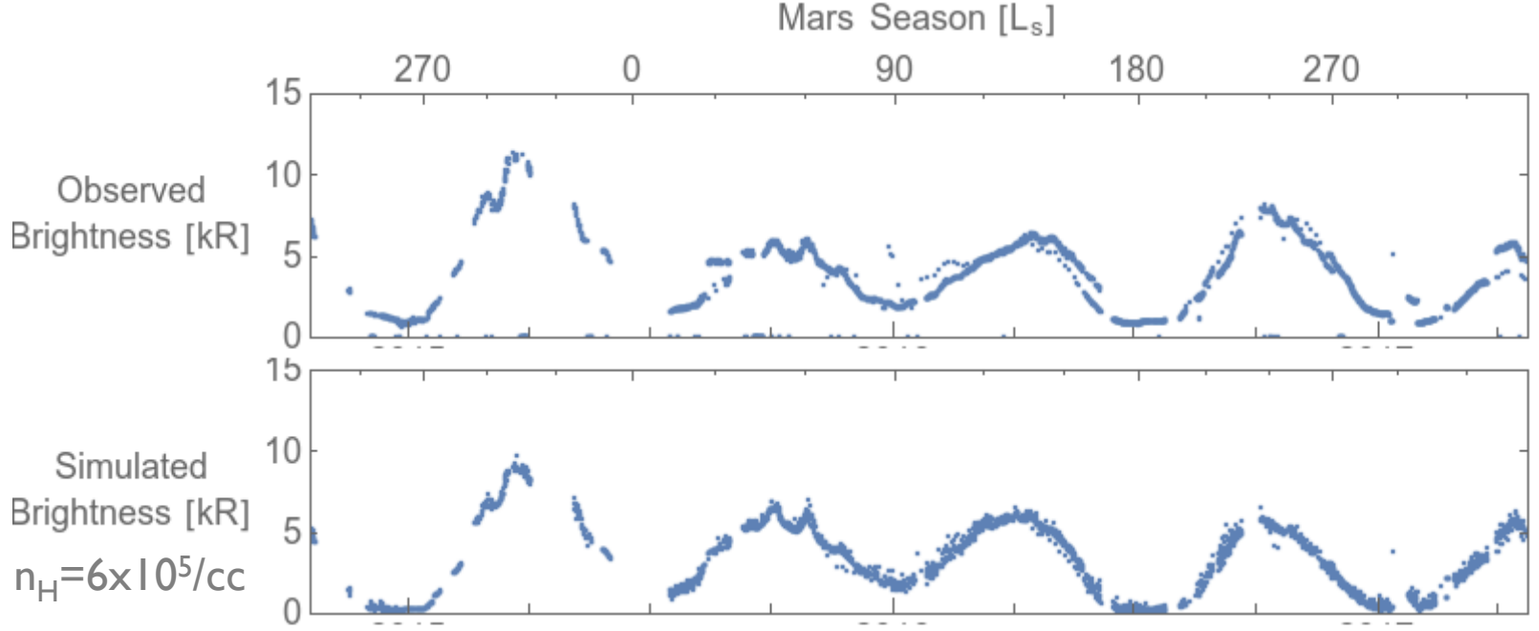
NGIMS can provide local H temp assuming collisional equilibrium



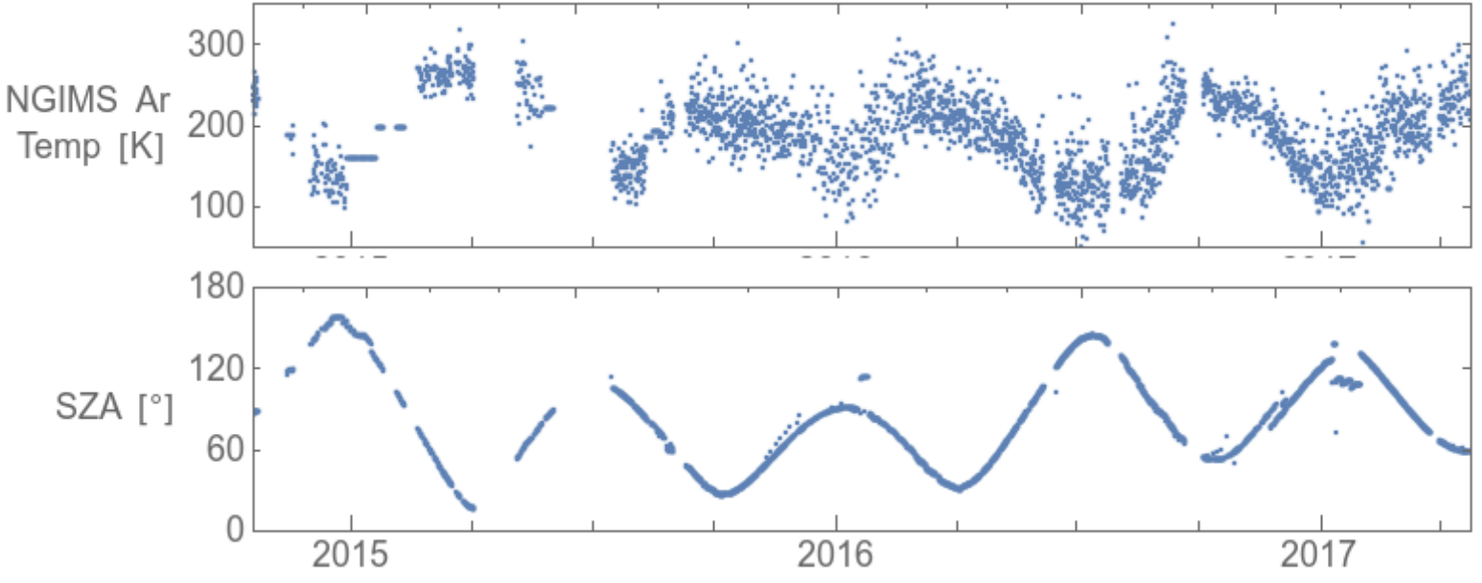


NGIMS Temp provided by Shane Stone

Model with NGIMS temp cannot reproduce IUVS brightness



Observed brightness is sometimes larger than simulated brightness at ANY density.



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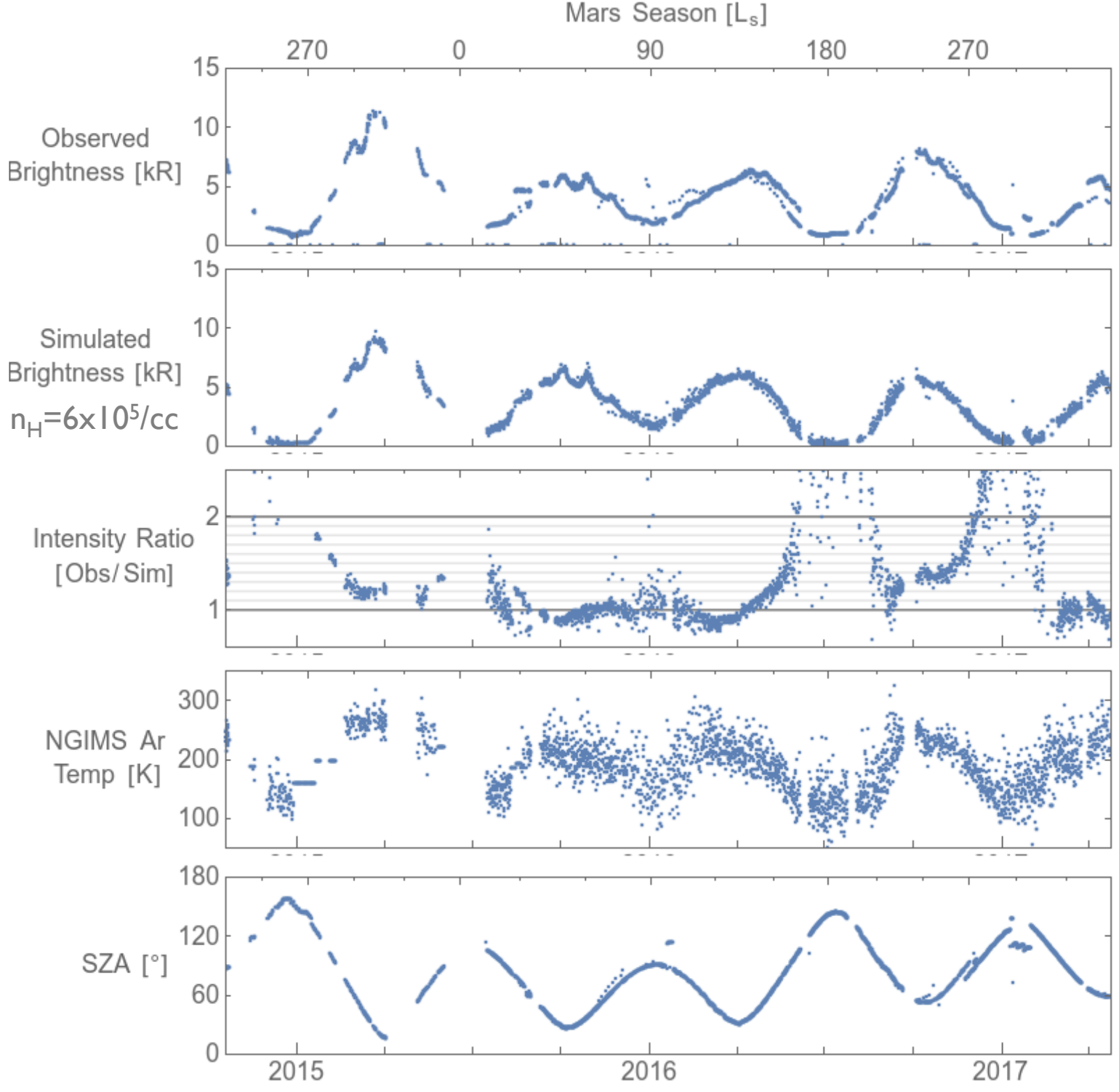

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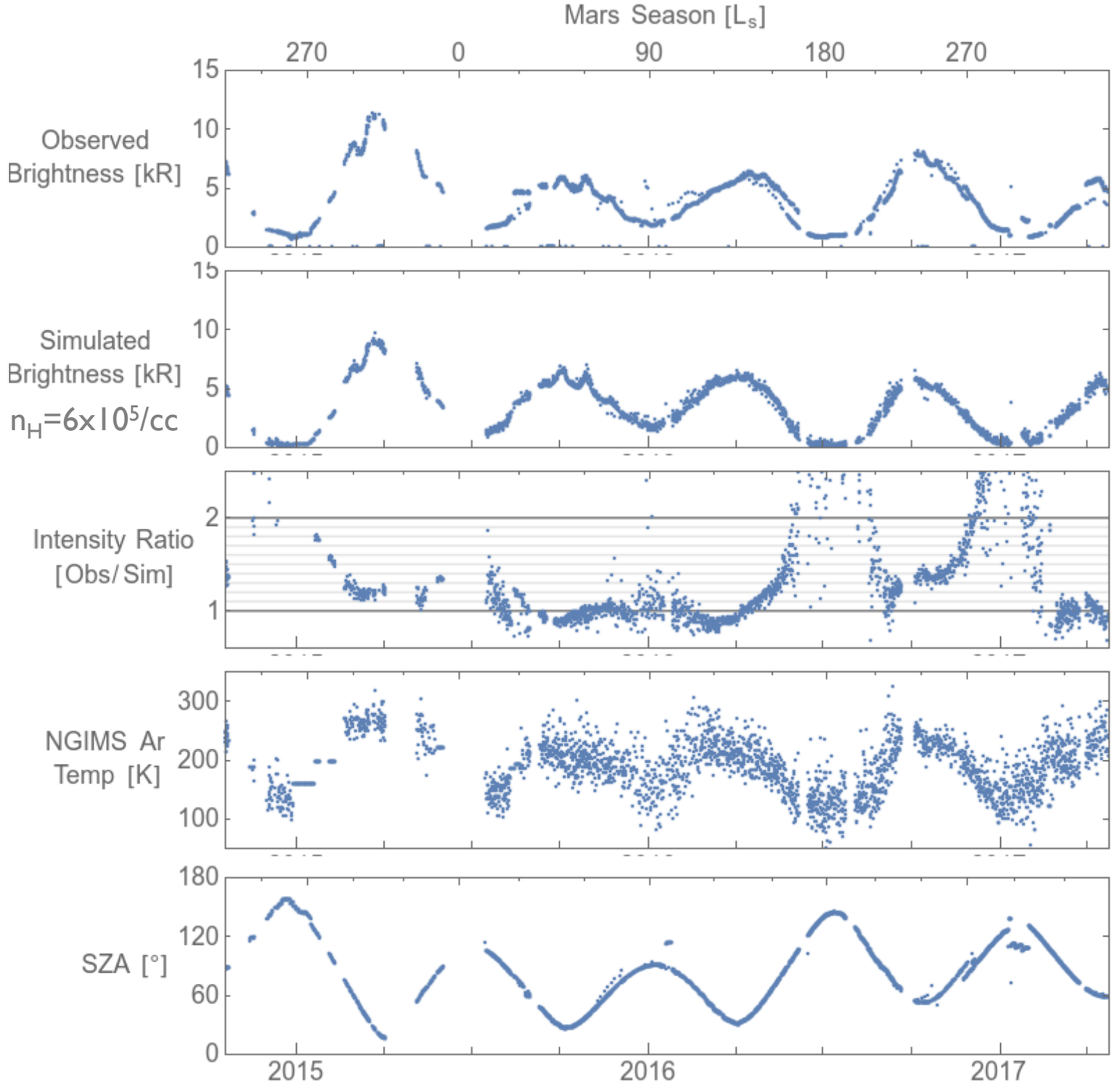

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At high SZA, this indicates local temp is inadequate for global simulation.

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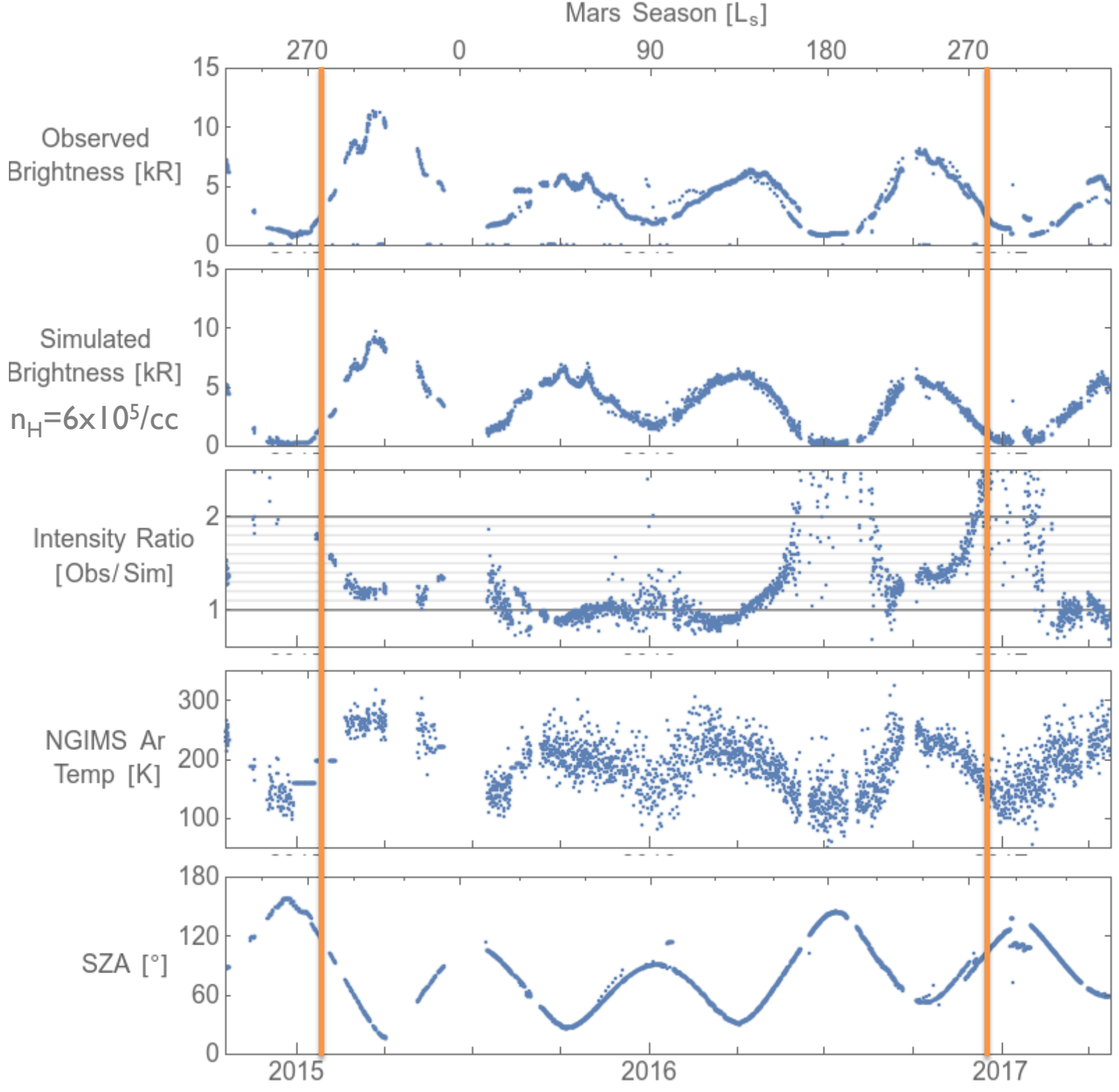

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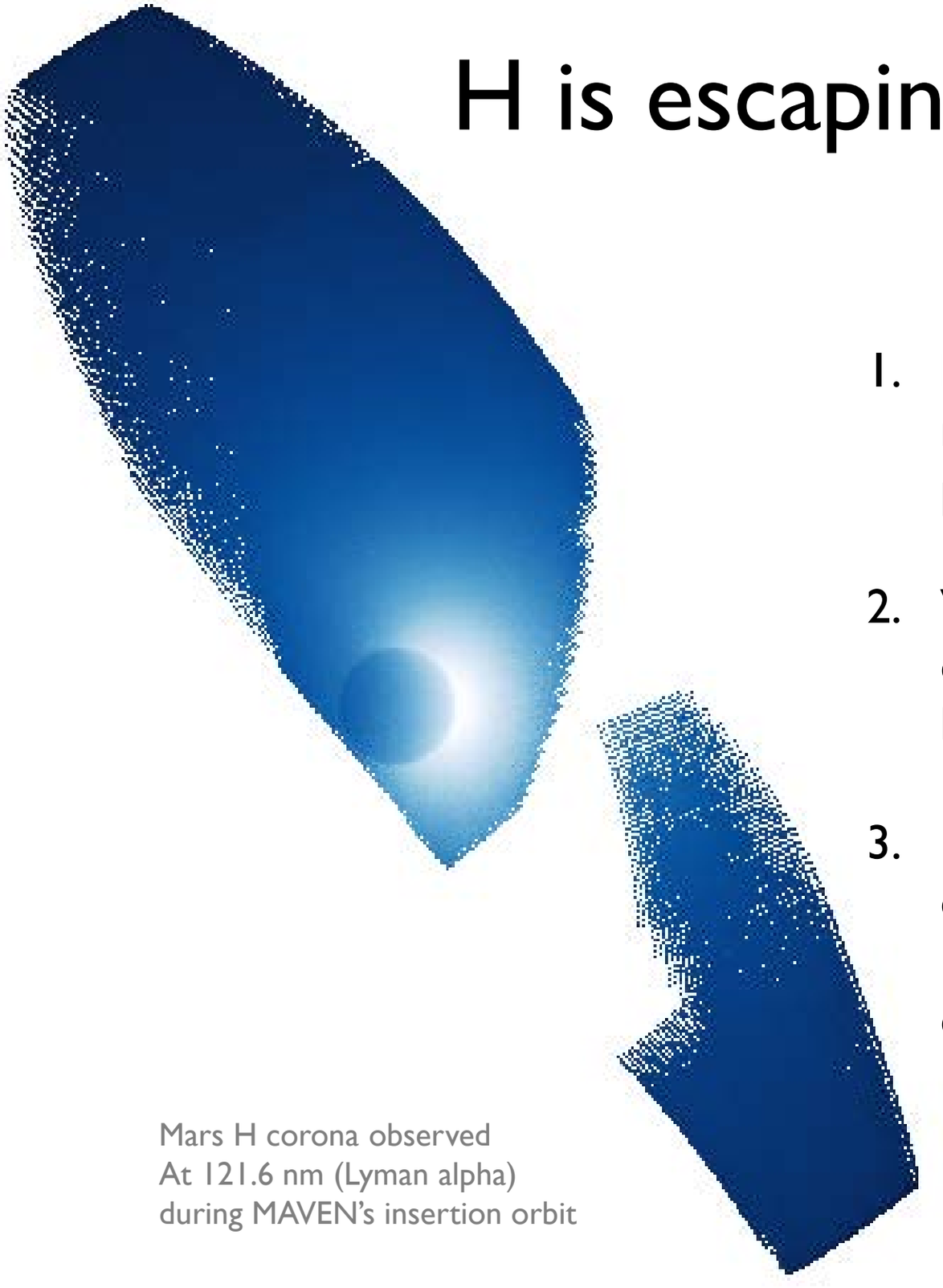
Similar brightness at Ls~270, SZA~90 indicates similar escape rates in subsequent Mars years.

H is escaping from Mars today via Jeans escape



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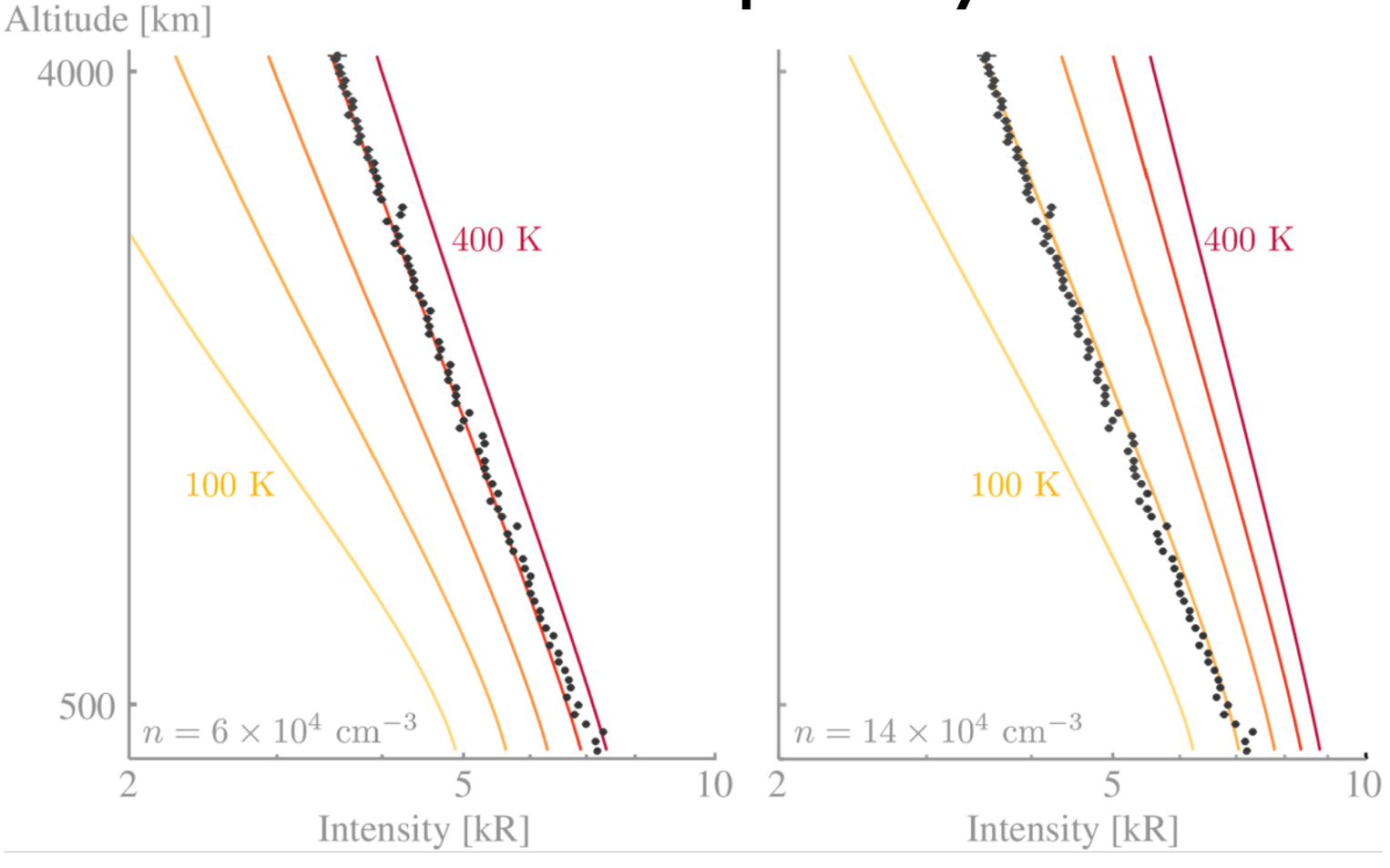
1. MAVEN derived H escape rates are near 1-8 x 10^8/cm^2/s (10^{26}-10^{27} /s); profiles require hot H or D.

2. Variation in derived rates between coronal profiles requires rapid change between Ls~200-250.

3. Periapse data suggests large seasonal change, low interannual variability at Ls~270. 2D+ model interpretation to come soon.

Data/Model comparison constrains the corona

...but density and temperature are degenerate, because H is optically thick.



Escape Rate Contours

Absolute calibration is also difficult, producing a systematic uncertainty that must be propagated.

MCMC techniques account for degeneracy and systematic nuisance parameters like calibration.